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(58) Field of search
F4U

(54) Electrical storage heater

(57) A heat storage core (36) in an upper compartment (11) and a fan motor (35) in a lower compartment (12) are separated by a duct (23) through which cooling air can flow by convection to a duct (26). A further cooling air duct (24) is located below the fan compartment.

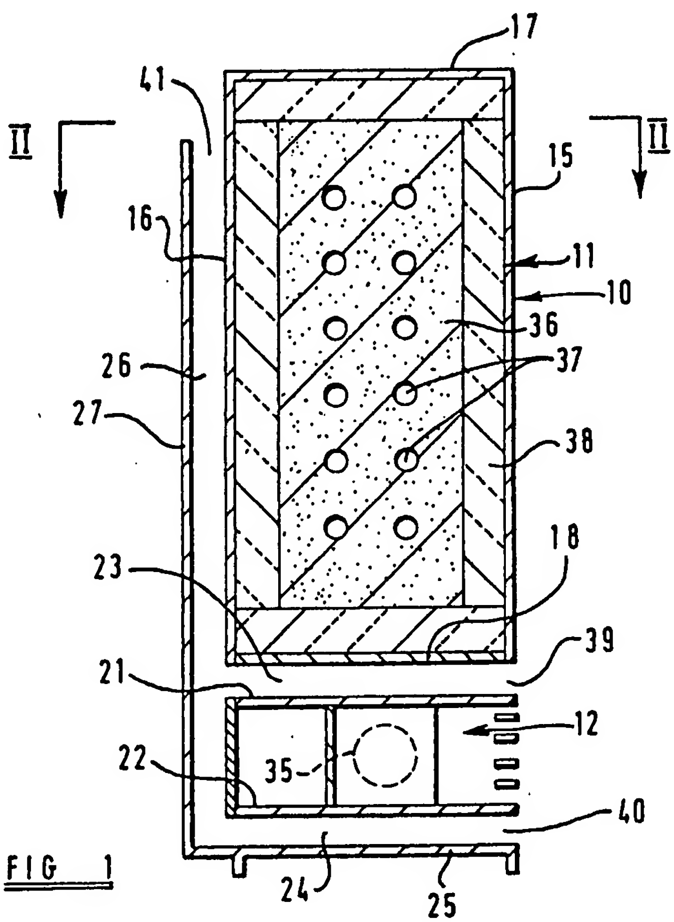

FIG 1

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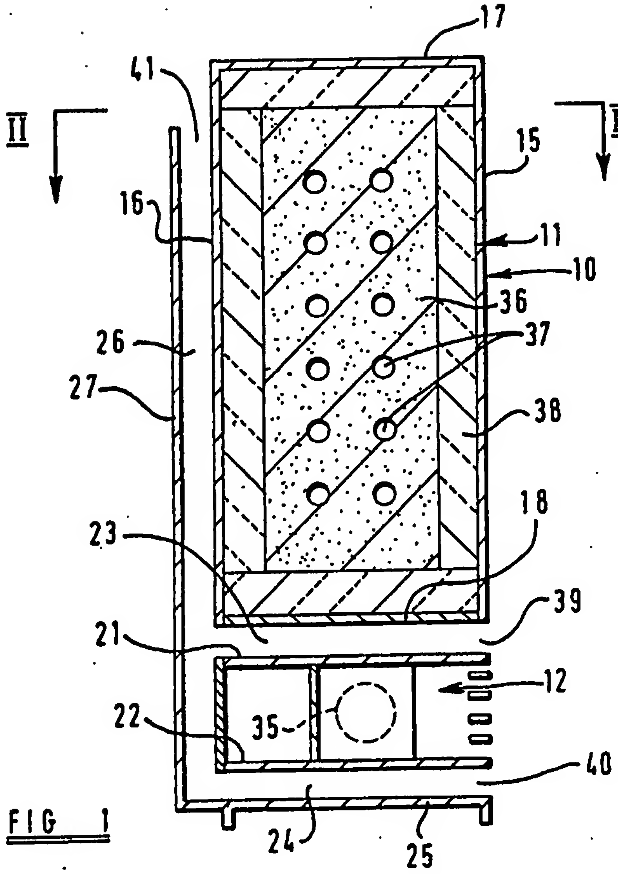

FIG 1

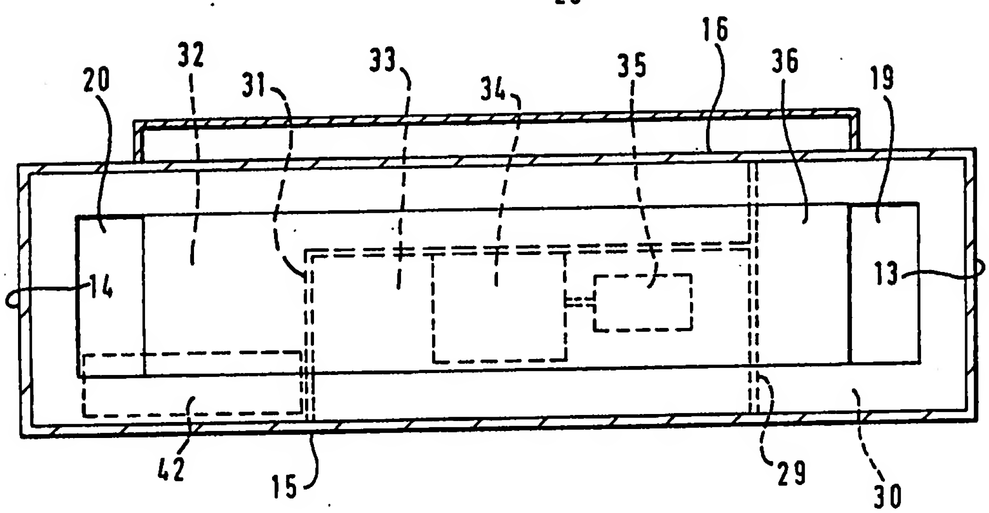

FIG 2

SPECIFICATION

Electrical storage heater and method of operating same

This invention relates to an electrical storage heater, by which we mean apparatus comprising a housing, a heat storage core contained in the housing, electrically energisable heating elements associated with the core and passages along which air can flow from outside the heater through the heater in heat exchange relation with the core and from the heater to transfer heat from the core to a region outside the heater. The core of an electrical storage heater is usually provided with thermal insulation to reduce the loss of heat from the core other than to air flowing through the passages and there is generally provided means for regulating the flow of air through the passages so that the rate of transfer of heat from the core can be controlled, at least to some extent. The regulating means commonly includes a fan for causing air to flow along the passages and may also include one or more valves for controlling flow of air through the passages and/or mixing of ambient air at a substantially lower temperature with air which has flowed in thermal communication with the core to provide a mixture of air at a selected temperature which can be discharged from the heater.

The regulating mans of a heat storage heater are generally disposed outside the thermal insulation associated with the core, so that the regulating means is not subjected to the maximum temperature achieved in the core. However, we believe that the regulating means of known electrical storage heaters is adversely affected by heating of the regulating means which inevitably occurs during use of the storage heater.

According to a first aspect of the present invention, there is provided an electrical storage heater comprising a housing, a heat storage core and regulating means for regulating the flow of air through the core, wherein the housing defines first and second compartments, a cooling duct disposed between the first and second compartments, an inlet to the duct and an outlet from the duct; wherein the heat storage core is contained in the first compartment and wherein at least a part of the regulating means is disposed in the second compartment.

If air at a lower temperature than that of the core is caused or permitted to flow through the cooling duct of a storage heater according to the invention, that air will carry heat away from the cooling duct and thereby reduce the transfer of heat from the first compartment to the second compartment.

The outlet of the cooling duct is preferably at a level above the inlet to the cooling duct so that air will tend to flow by convection along the cooling duct from the inlet thereof to the outlet. To promote such convection, the housing may define a further duct which extends from the cooling duct upwardly along a boundary of the first compartment to the outlet from the cooling duct. With this arrangement, heat escaping from the first compartment at said boundary thereof will be received by air in the further duct and this will promote convective flow through the cooling duct and through the further duct to the outlet.

According to a further aspect of the invention, there is provided a method of operating a storage heater having a heat storage core defining air heating ducts, electrical heating elements for supplying heat to the core and a fan for causing air to flow through the air heating ducts, wherein electrical power is supplied to the heating elements during a charging period, during a supply period, the fan is energised to cause air to flow through the air heating ducts and then out of the heater to carry heat away from the heater and wherein, during at least a part of the charging period, heat is carried out of the heater from a region between the core and the fan by a convective flow of air at a temperature below that of the core along a path which lies between the core and the fan.

The supply period may overlap partly with the charging period. If the temperature of the core is above the ambient temperature at the beginning of a charging period, then heat will be carried out of the heater by said convective flow throughout the charging period. The convective flow is not limited to the supply period.

According to a further aspect of the invention, there is provided an electrical storage heater comprising a housing, a heat storage core and regulating means for regulating the flow of air through the core, wherein the housing defines a passage extending from an air inlet to the housing, in heat-transfer relation with the core and downwardly from the core to an air outlet from the heater and the housing further defines a cooling duct which lies directly below that part of the passage through which air flows downwardly from the core, the arrangement being such that heat can be extracted by air flowing through the cooling duct from a wall which divides the cooling duct from the passage.

According to a still further aspect of the invention, there is provided a method of operating a storage heater having a heat storage core defining air heating ducts, electrical heating elements for supplying heat to the core and a fan for causing air to flow along a first path which includes the air heating ducts and a further part which extends downwardly from the air heating ducts, and wherein air is caused to flow along a second path below said part of the first path, to extract heat from

a wall on which the flow of air from the heating ducts impinges.

An example of a heater embodying the invention and which is used in a method in accordance with the invention will now be described, with reference to the accompanying drawing, wherein:–

Figure 1 shows diagrammatically a cross-section of the heater in a vertical plane; and

Figure 2 shows diagrammatically a cross-section on the line II–II of Fig. 1.

The heater illustrated in the drawing comprises a housing 10 which, in the example illustrated, is fabricated from steel sheet, and which defines an upper compartment 11 and a lower compartment 12. The upper compartment extends along the entire length of the housing between side walls 13 and 14 and across a major part of the width of the housing between a front wall 15 and a rear wall 16. The housing includes a horizontal top wall 17 which defines an upper boundary of the compartment 11 and a horizontal floor 18 which defines a lower boundary of the compartment 11.

There are between opposite ends of the floor 18 and the side walls 13 and 14 respective gaps 19 and 20 through which air can enter and leave the upper compartment. Apart from the gaps 19 and 20, the boundaries of the upper compartment are substantially airtight.

The housing 10 includes upper and lower horizontal partitions 21 and 22, both of which lie below the floor 18. The upper partition 21 is spaced downwardly from the floor 18 by a relatively short distance, typically 2% of the overall height of the heater, and has a length no greater than that of the floor 18, so that opposite ends of the partition 21 are spaced from the side walls 13 and 14 of the housing 10 by gaps coinciding with the gaps 19 and 20. Upturned flanges on opposite ends of the partition 21 are secured in substantially airtight relation to the floor 18 so that there is defined between the floor and the upper partition 21 a cooling duct 23 which is open only adjacent to the front and adjacent to the rear of the housing.

A further cooling duct 24 is defined in a similar way between the lower partition 22 and a bottom wall 25 of the housing. The duct 24 also is open only adjacent to the front and adjacent to the rear of the housing.

At the rear of the housing, there is provided a further duct 26 defined between the rear wall 16 and a vertical wall 27 which is substantially parallel to the rear wall and spaced therefrom in a direction away from the front of the housing.

The lower compartment 12 lies partly between the upper and lower partitions 21 and 22. The upper partition may extend from one of the gaps 19 and 20 to the other. Alternatively, the upper partition may be somewhat shorter so that the floor 18 defines a part of the upper boundary of the lower compartment. Similarly, the lower partition 22 may have a length equal to that of the floor 18 or may be somewhat shorter.

The housing further includes a wall 29 which divides one end portion of the lower compartment 12 from the remainder of that compartment, this end portion constituting an admission chamber 30 which is in direct communication with the upper compartment 11 through the gap 19. A further wall 31 partly divides the remainder of the lower compartment 12 into a mixing chamber 32 and a fan chamber 33. The mixing chamber communicates directly with the upper compartment 12 through the gap 20. The fan chamber 33 lies between the mixing chamber and the admission chamber 30.

At the front of the housing 10, each of the chambers 30, 32 and 33 is at least partly open to the ambient atmosphere. The front boundaries of these chambers may be defined by grills or other structures which prevent insertion of all but very small objects into the chambers and obscure the interiors of the chambers from view. In the chamber 33, there is mounted a fan 34 and an electrically energisable motor 35 for driving the fan. The fan has a casing which covers the opening between the mixing chamber 32 and the fan chamber 33.

The upper compartment 11 contains a heat storage core 36 which defines horizontal passages 37 extending through the core from one end portion of the upper compartment to the opposite end portion thereof. With the exception of the gaps 19 and 20, the core is entirely surrounded by a layer of thermally insulating material 38. At the ends of the core, the material 38 is spaced from the core to enable air to flow between the passages 37 and the gaps 19 and 20.

Electrical heating elements (not shown) extend through the core 36, conveniently through the passages 37. The structure and arrangement of the core and associated heating elements may be a known arrangement. Switches for controlling energisation of the heating elements associated with the core and energisation of the motor 35 are mounted on the housing 10, preferably adjacent to the admission chamber 30 and away from the fan chamber 33.

When the heater is to be used, an electrical power source is connected with the heating elements associated with the core to raise the temperature of the latter in the usual way. As the temperature of the core rises above the ambient temperature, heat will escape from the core at all boundaries of the upper compartment 11, although the thermal insulation 38 will maintain the rate of loss of heat at a fairly low level, whilst the motor 35 is deenergised.

Heat which flows from the core through the rear wall 16 will be transmitted to air in the further duct 26. Accordingly, the temperature of this air will rise above the ambient temperature and there will be established a convective flow into the cooling ducts 23 and 24 through inlets 39 and 40 thereto at the front of the housing 10, to the further duct and upwardly within the further duct to the outlet 41 therefrom at the top of the wall 27.

Heat which escapes from the core at the lower boundary of the upper compartment 11 will be transferred partly to air flowing through the cooling duct 23 to be carried out of the heater. Thus, the transmission of heat from the core to the lower compartment 12 will be reduced, as compared with the transmission which would occur in the absence of the cooling duct 23. Air flowing through the cooling duct 24 will extract heat from the lower partition 22 and therefore from the contents of the lower compartment 12, thereby making a further contribution to the avoidance of high temperatures in the lower compartment. It will be noted that there are no valves for closing the cooling ducts 23 and 24 and the further duct 26.

The spacing between the rear wall 16 and the wall 27 is greater than, preferably approximately twice as great as, the spacing between the floor 18 and the upper partition 21. Accordingly, particularly in a case where the lower cooling duct 24 does not extend across the entire length of the lower compartment 12, the cross-sectional area of the air flow passage provided by the further duct 26 will be substantially greater than that provided by the ducts 23 and 24, and the air speed in these latter ducts will be somewhat higher than the air speed in the duct 26. This leads to improved heat transfer from the floor 18 to air in the duct 23.

When heat is required to be discharged from the heater at a higher rate, the fan motor 35 is energised. The fan then draws air from the admission chamber 30, where the air enters the heater, through the passages 37 in the core and through the mixing chamber 32 to discharge that air, which has been heated by the core, from the heater at the front boundary of the fan chamber 33.

Hot air which flows from the passages 37 in the core to the mixing chamber 32 tends to impinge on the lower partition 22. This partition is cooled, both whilst the fan motor 35 is energised, and when the fan is not driven, by the convective flow of air through the duct 24. This reduces the transmission of heat to the bottom wall 25, as compared with the rate of transmission which would apply if there was no flow of air through the duct 24. Air present in the duct 24 insulates the wall 25 from the lower partition 22. Furthermore, the convective flow through the duct 24 may cool the wall 25 if the temperature of the latter rises above the ambient temperature.

Whilst we prefer to use the upper cooling duct 23 and the lower cooling duct 24 together, either one of these cooling ducts could be omitted from the heater without seriously impairing the benefits derived from the remaining cooling duct.

It will be noted that the flow of air through the passages 37 in the core which is promoted by the fan 34, enters and leaves the upper compartment 11 through the gaps 19 and 20 which are at the same level and are below the core. Accordingly, when the motor 35 is de-energised, there will be no convective flow of air along the same path as air is caused to flow by the fan when the motor is energised. It will be noted that the flow path along which the convective flow of air through the cooling ducts 23 and 24 and the further duct 26 takes place is separate from the flow path along which air is caused to flow by the fan.

The fan and motor form a part of regulating means for regulating the transfer of heat from the heater. When the motor 35 is de-energised, heat can be transferred from the heater only at a very low rate, as compared with the rate at which heat can be transferred when the motor is energised and the core is at a high temperature.

The regulating means may further comprise a mixing valve 42 disposed in the mixing chamber 32 for controlling the admission of air to that chamber from outside the heater at the front of the housing. The mixing valve may be used to avoid large changes in the temperature of the air which leaves the heater through the fan chamber 33, ambient air being admitted to the mixing chamber 32 at the front of the housing at a relatively high rate when the core temperature is high and at a relatively low rate, or not at all, when the core temperature is low. The mixing valve may be controlled or by a sensing element (not shown) over which air leaving the upper compartment 11 through the gap 20 flows. This sensing element is preferably disposed in the mixing chamber 32 below the cooling duct 23 so that the sensing element is influenced predominently by air flowing from the core into the lower compartment, rather than by transmission of heat in other ways from the core.

The upper cooling duct 23 may be divided by vertical webs which coincide at least approximately with the positions of the walls 29 and 31, to support the floor 18 from these walls. Similar provision may be made for transmitting load from the walls 29 and 31 to the bottom wall 25 in cases where the lower cooling duct 24 underlies the walls 29 and 31.

CLAIMS

1. An electrical storage heater comprising

a housing, a heat storage core and regulating means for regulating the flow of air through the core, wherein the housing defines first and second compartments, a cooling duct disposed between the first and second compartments, an inlet to the cooling duct and an outlet from the cooling duct, wherein the heat storage core is contained in the first compartment and wherein at least a part of the regulating means is disposed in the second compartment.

2. A heater according to Claim 1 wherein said outlet is above the level of the inlet.

3. A heater according to Claim 2 wherein the housing defines a further duct extending from the cooling duct upwardly along a boundary of the first compartment to the outlet.

4. A heater according to any preceding claim wherein said outlet is nearer to the level of the top of the first compartment than to the level of the bottom of the first compartment.

5. A heater according to Claim 3 or according to Claim 4 as appendant to Claim 3 wherein the first compartment is an upper compartment, the second compartment is a lower compartment and the housing further defines a lower duct below the lower compartment and communicating with the further duct.

6. A heater according to any preceding claim wherein the regulating means includes an impeller and an electric motor for driving the impeller, the motor being disposed in the second compartment.

7. A heater according to any one of Claims 1 to 4 wherein the first compartment is an upper compartment, the second compartment is a lower compartment and the regulating means includes a mixing valve and a temperature-sensitive element for controlling the mixing valve, said element being disposed in the lower compartment beneath the cooling duct.

8. A heater according to Claim 7 as appendant to Claim 5 wherein the temperature-sensitive element lies over the lower duct.

9. A method of operating a storage heater having a heat storage core defining air heating ducts, electrical heating elements for supplying heat to the core and a fan for causing air to flow through air heating ducts, wherein electrical power is supplied to the heating elements during a charging period, during a supply period, the fan is energised to cause air to flow through the air heating ducts and then out of the heater to carry heat away from the heater and, during at least a part of the charging period, heat is carried out of the heater from a region between the core and the fan by a convective flow of air at a temperature below that of the core along a path which lies between the core and the fan.

10. A heater substantially as herein described with reference to the accompanying drawing.

11. A method of operating an electrical storage heater substantially as herein described with reference to the accompanying drawings.

12. Any novel feature or novel combination of features disclosed herein and/or shown in the accompanying drawing.

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